

Full Length Research Paper

Teachers' perceptions of classroom behaviour and working memory

Tracy Packiam Alloway*, Gwyneth Doherty-Sneddon and Lynsey Forbes

Centre for Memory and Learning in the Lifespan, Stirling University, Stirling, Scotland.

Accepted 3 February, 2012

Working memory, ability to remember and manipulate information, is crucial to academic attainment. The aim of the present study was to understand teachers' perception of working memory and how it impacts classroom behaviour. A semi-structured interview was used to explore teachers' ability to define working memory, identify these difficulties in the classroom, and effectively support struggling students. Teachers were then asked to identify students in their classroom whom they felt exhibited troublesome behaviour. The data indicated that teacher awareness of working memory was quite low, with the majority of them only able to correctly identify one or two signs of working memory failure and effective strategies to support it in the classroom. The study also found that students the teachers consider as troublesome showed signs of working memory failure. The practical implications for screening and supporting students who exhibit troublesome behaviour in the classroom are discussed.

Key words: Working memory, classroom behaviour, strategies, teacher rating scales.

INTRODUCTION

Working memory refers to our ability to store and manipulate information for brief periods (Just and Carpenter, 1992). It is typically measured by dual-tasks, where the individual has to remember an item while simultaneously processing sometimes unrelated piece of information. A widely used working memory task is the reading span task where the individual reads a sentence, verifies it, and then recalls the final word (Daneman and Carpenter, 1980). Individual differences in working memory performance are closely related to a range of academic skills such as reading (Swanson and Beebe-Frankenberger, 2004), spelling (Alloway et al., 2005), comprehension (Daneman and Merikle, 1996), and mathematics (Bull and Scerif, 2001; Geary et al., 1999; Swanson and Sachse-Lee, 2001). Crucially, there is emerging research that working memory predicts learning outcomes independently of intelligence quotient (IQ) (Alloway, 2009a; Cain et al., 2004; Gathercole et al., 2006). While working memory capacity increases in development (Alloway et al., 2006; Swanson, 1999), it

appears to be a relatively stable construct and changes very little relative to peers. The educational implications are that a child's working memory skills at 5 years is one of the best predictors of academic success six years later (Alloway and Alloway, 2010; Alloway, 2009). Thus, it is crucial that educators are able to recognize working memory deficits and support students accordingly.

In addition to academic attainment difficulties, students with poor working memory exhibit specific patterns of problematic classroom behaviour that are distinct from behavioural problems such as attention deficit hyperactivity disorder (ADHD). In a large-scale screening study, teachers were asked to rate the classroom behaviour of students with working memory difficulties (Alloway et al., 2009a). The students were typically judged by teachers to have poor attention span and high levels of distractibility but did not display hyperactive or impulsive behaviour characteristic of ADHD (Aronen et al., 2005; Gathercole et al., 2008).

Given the importance of working memory in academic attainment, it is of value to understand teachers' perception of working memory and how it impacts classroom behaviour. In the current study, the researcher evaluated teachers' knowledge and awareness of working

*Corresponding author. E-mail: t.p.alloway@stir.ac.uk.

memory problems in their students. A semi-structured interview was used to explore teachers' ability to define working memory, identify these difficulties in the classroom, and effectively support struggling students.

Teachers were then asked to identify students in their classroom whom they felt exhibited troublesome behaviour. As this appears to be the first study to systematically compare teachers' perceptions of students with troublesome behaviour with behaviour associated with working memory problems, the students were not clinically diagnosed with attention deficit hyperactivity disorder and were from mainstream schools. This is an important issue as previous research on troublesome classroom behaviour has been restricted to students with ADHD (Alloway et al., 2009b).

In the current study teachers were also asked whether the students' negative classroom behaviour could be best attributed to internal reasons (for example, unmotivated) or external reasons (for example, difficult home life). Of interest was whether teachers would identify working memory as a possible factor linked to negative or troublesome behaviour. Pilot data indicates that when teachers were asked to describe the behaviour of five-year olds with learning difficulties they rarely identified poor working memory as a source of their difficulties (Gathercole et al., 2006). The present study extends these findings to a larger sample of students from a wider age range.

The next issue of interest was whether children identified by their teachers as exhibiting negative classroom behaviour would be more likely to display behaviours associated with working memory deficits compared to other children in their class. For example, do these students often abandon tasks before completion or do they frequently incorrectly repeat the same response. Teachers completed a checklist for each student using the working memory rating scale (WMRS) (Alloway et al., 2008) to quantify the frequency of their behaviours associated with working memory problems. Although there are existing teacher assessments of classroom behaviour that include features of working memory, such as the behaviour rating inventory of executive function (BRIEF) (Gioia et al., 2000) and the Conners' teacher rating scale (CTRS) (Conners, 2005), they fail to capture the full behavioural profile typifying children with poor working memory (Alloway et al., 2009c). The working memory rating scale consists of 20 descriptions of these problem behaviours, and was designed to enable teachers to identify children at risk of the learning difficulties associated with working memory deficits. Key features of this tool are that it can be rapidly administered and simple to score. It focuses solely on working memory related problems in a single scale, and does not require any training in psychometric assessment prior to use. The first prediction of the current work is that within the sample, teachers will vary in their: knowledge of working

memory; recognition of working memory deficits; and strategies to cope with such deficits. The second prediction is that children who are a priori identified by their teachers as being troublesome in the classroom will have poorer working memory function than those who do not exhibit problematic behaviours.

MATERIALS AND METHODS

Semi-structured interview

Prior to identifying students with troublesome behaviour, semi-structured interviews were conducted to assess the teachers' working memory knowledge as well as elicit their behavioural descriptions of the children. Their awareness of working memory was categorized as follows. Category 1 includes questions about their knowledge of working memory. Teachers were awarded a point for each correct definition of working memory that include terms such as 'memory', 'processing', or related words. They were also given a point for valid examples of working memory, such as giving instructions for a classroom activity. Category 2 assessed their awareness of working memory deficits in students, as well as early warning signs of working memory deficits. One point was given for each correctly identified sign of working memory problems as listed in the working memory rating scale (Alloway et al., 2008). In category 3, they were asked to list strategies that they would use to support students with poor working memory in the classroom. They received a point for each valid strategy to support working memory in the classroom. Correct responses included: 'You can give them a plan which details what they have got to do. It can be visual or it can be written' and 'you can ask them to relay the instructions back to you (Gathercole and Alloway, 2008)'. Responses were recorded for subsequent content analysis. Higher scores reflected an excellent awareness of working memory in the classroom, while lower scores suggest less awareness of the link between working memory and learning. In order to assess inter-rater reliability of the interview scores, 20% of the teacher interviews were scored by an independent experimenter. Scores were equivalent in 93% of cases, establishing a high degree of consistency between raters.

Behaviour rating scale

The working memory rating scale (Alloway et al., 2008) consists of 20 descriptions of behaviours that are characteristic of children with working memory deficits. Examples include: 'The child raised his hand but when called upon, he had forgotten his response'; 'She lost her place in a task with multiple steps'; and 'The child had difficulty remaining on task'. Teachers are asked to rate how typical each behaviour is of a target child, using a four-point scale ranging from (0) not typical at all to (1) occasionally to (2) fairly typical to (3) very typical. T-scores (mean=50; SD=10) were recorded on the basis of age-specific norms.

Procedure

First, the participating teachers were interviewed by one of the authors (Lynsey Forbes). They then identified students in their class who exhibited negative behaviour (and gave examples of negative behaviours typically exhibited by each child), as well as age-matched controls. Finally, the teachers completed the WMRS for both groups of children.

Table 1. WMRS T-scores and interview scores.

	WMRS T-score	Category 1	Category 2	Category 3
WMRS T-score	1			
Category 1	0.17	1		
Category 2	0.14	0.49	1	
Category 3	0.18	0.26	0.32	1

Participants

A total of 14 classroom teachers in Scotland participated in this study. In order to meet the criteria for this research, teachers were permanent members of staff who had been in regular contact with their class for at least one month. Classroom teachers were asked to think of children in their class whom they felt exhibited troublesome behaviour. A total of 23 children aged between 5 to 10 years were identified ($M=8$ years, $SD=2$ years; 19 boys). Teachers were then asked to select students from the same class whom they felt did not exhibit negative classroom behaviour. The control group consists of 23 age-matched students ($M=8$ years, $SD=2$ years; 20 boys). Parental consent was obtained for each participating child.

RESULTS

The results of the study are presented as follows. In category 1 (knowledge of working memory), all teachers were able to provide at least one correct response; scores ranged from 1 to 5, with a mean score of 2.2 points ($SD=0.89$). In category 2 (awareness of working memory deficits), there was a range of awareness, with 3 of the 14 teachers indicating that there were unaware of signs of working memory problems, while further three teachers each identified six signs of working memory failure (mean=2.6; $SD=1.99$). In category 3 (strategies for intervention), scores ranged from 1 to 7 (mean=1.8; $SD=1.24$), with every teacher producing at least one strategy to support students' with working memory problems, even if they were not aware of working memory deficits in their students (category 1).

When teachers were asked to provide examples of the negative behaviour typical of each child and their perception of reasons for this behaviour, they only cited behaviour associated with working memory deficits such as 'unable to complete tasks independently' and 'underachieving in most things' as troublesome 25% of the time. Examples of troublesome behaviour not explicitly associated with working memory deficits include 'loud in inappropriate situations', 'he is demanding and bossy', and 'is moody and disruptive'. When asked whether such negative behaviour was motivated by internal or external reasons, the majority of instances were thought to be internally motivated (71%), however working memory was never listed as one of these reasons. Instead, comments such as 'he has a quick temper' or 'she is a little princess' were listed as internal

factors for negative behaviour. External reasons included 'He has a younger sibling and may not be getting enough attention at home' or 'He has a lack of positive attitudes at home.'

Inspection of the WMRS T-scores indicate that the troublesome children had a mean score of 62.04 ($SD=9.05$) and the control group had a mean score of 47 ($SD=11.54$). As a guide, scores of 55 or below on the WMRS do not represent a cause for concern, while scores above 60 can be viewed in terms of increasing risk of impairment (Alloway et al., 2009b). What proportion of students identified with problem classroom behaviour also exhibited problem behaviours associated with working memory? The incidence of working memory rating scores of 60 or greater (1 SD above the mean of 50) was calculated. While 65% of students with troublesome behaviour ($n=15$) had elevated WMRS ratings, only 17% of the students in the control group ($n=4$) received ratings indicative of problems behaviours in the classroom. This high proportion suggests that the students who receive high scores on WMRS were also perceived by teachers to exhibit troublesome behaviour in the classroom. A t-test performed on the WMRS scores as a function of group confirmed a significant difference between groups, $t(44) = 4.92$, $p < 0.001$.

In order to understand the relationship between teachers' awareness of working memory and classroom behaviour, correlation analyses were conducted between WMRS T-scores and interview scores on the whole sample. Table 1 shows the correlation values between these two types of scores. WMRS T-scores were not significantly associated with teachers' responses on working memory awareness (Categories 1 to 3; r s ranged between 0.14 to 0.18; NS). The link between teachers awareness of working memory (Category 1) and their knowledge of signs of working memory failure (category 2) was significant; $r=0.49$, $p < 0.01$. There was also a significant relationship between their knowledge of signs of working memory failure (Category 2) and ability to identify strategies to support working memory (Category 3; $r=0.32$, $p < 0.05$).

DISCUSSION

The present study represents the first systematic investigation of the relationship between teachers' awareness

of working memory and classroom behaviour. There are two key findings. First, the data indicated that teacher awareness of working memory was quite low, with the majority of them only able to correctly identify one or two signs of working memory failure and effective strategies to support it in the classroom. Early warning signs of working memory failure were only picked up 25% of the time, despite high teacher ratings of working memory behavioural difficulties in the majority of the troublesome children. The correlation analyses suggest that teachers were either aware of working memory as a concept and could recognize problem signs in behaviour, or they were aware of what working memory is and were able to identify strategies to support these difficulties. However, the present group of teachers were not able to both recognize working memory problems and then support it. The interviews also revealed that teachers never listed working memory as an explanation for the students' troublesome behaviour. This pattern is consistent with anecdotal evidence that teachers tend to misattribute signs of poor working memory as 'lacking motivation' or 'daydreaming' (Gathercole et al., 2006).

The second key finding in the present study is that students that teachers consider as troublesome showed signs of working memory failure. This profile is in line with accumulating evidence that working memory difficulties not only impact academic attainment, but classroom functioning as well (Alloway et al., 2009c; Engle et al., 1991). In the present study, students were underachieving in the classroom and struggled to complete their assignments. Their working memory problems may also have affected their disposition: they were reported as being moody and disruptive, which may have stemmed from frustration in the classroom. In a large-scale screening study, students with working memory problems were reported to struggle with self-esteem, particularly in areas that reflected their sense of their ability to impact their surroundings (Alloway et al., 2009a).

This important link between troublesome behaviour and working memory problems suggests that early screening can provide a useful first step in supporting these students. The Working Memory Rating Scale provides a quick and efficient way for early identification of working memory problems that will impair learning and is conormed with the cognitive assessments of working memory to provide a reliable tool for routine screening of memory difficulties (Alloway et al., 2009c). Recent research confirms that the WMRS provides a more accurate assessment of problem behaviours associated with working memory difficulties than existing teacher rating scales such as the BRIEF and the Conners' teacher rating scale (Alloway et al., 2009b). There is also exciting evidence that working memory can be trained (Jaeggi et al., 2008) and can lead to improvements in academic attainment (Alloway, in press; Holmes et al., 2009).

Conclusion

The present investigation provides an important first step in understanding how teachers view working memory problems in their students. The present study suggests that teachers' awareness of working memory can be well supported by existing tools for educators to facilitate early screening and training.

REFERENCES

- Alloway TP (2009). Working memory, but not IQ, predicts subsequent learning in children with learning difficulties. *Euro. J. Psychol. Ass.*, Alloway, T.P. (in press). Can interactive working memory training improve learning? *J. Interactive Learn. Res.*, 25: 92-98.
- Alloway TP, Alloway RG (2010). Investigating the predictive roles of working memory and IQ in academic attainment. *J. Exp. Child Psychol.*, 106: 20-29.
- Alloway TP, Gathercole SE, Adams AM, Willis C, Eaglen R, Lamont E (2005). Working memory and other cognitive skills as predictors of progress towards early learning goals at school entry. *British J. Dev. Psychol.*, 23: 417-426.
- Alloway TP, Gathercole SE, Pickering SJ (2006). Verbal and visuo-spatial short-term and working memory in children: Are they separable? *Child Dev.*, 77: 1698-1716.
- Alloway TP, Gathercole SE, Kirkwood HJ, Elliott JE (2009). The cognitive and behavioural characteristics of children with low working memory. *Child Dev.*, 80: 606-621.
- Alloway TP, Gathercole SE, Holmes J, Place M, Elliott J (2009). The diagnostic utility of behavioural checklists in identifying children with ADHD and children with working memory deficits. *Child Psychiatry Hum. Dev.*, 40: 353-366.
- Alloway TP, Gathercole SE, Kirkwood HJ, Elliott JE (2009). The working memory rating scale: A classroom-based behavioural assessment of working memory. *Learn. Individ. Differences*, 19: 242-245.
- Alloway TP, Gathercole SE, Kirkwood H (2008). *Working Memory Rating Scale*. London: Pearson Assessment.
- Aronen ET, Vuontela V, Steenari MR, Salmi J, Carlson S (2005). Working memory, psychiatric symptoms, and academic performance at school. *Neurobiol. Learn. Memory*, 83: 33-42.
- Bull R, Scerif G (2001). Executive functioning as a predictor of children's mathematics ability: Inhibition, task switching, and working memory. *Dev. Neuropsychol.*, 19: 273-293.
- Cain K, Oakhill J, Bryant P (2004). Children's reading comprehension ability: concurrent prediction by working memory, verbal ability and component skills. *J. Educ. Psychol.*, 96: 31-42.
- Conners K (2005). *Conners' Teacher Rating Scale-Revised (S)*. New York: Multi-Health Systems Inc.
- Daneman M, Carpenter PA (1980). Individual differences in working memory and reading. *J. Verbal Learn. Verbal Behav.*, 19: 450-466.
- Engle RW, Carullo JJ, Collins KW (1991). Individual differences in working memory for comprehension and following directions. *J. Educ. Res.*, 84: 253-262.
- Gathercole SE, Alloway TP (2008). *Working memory and learning: A practical guide*. London: Sage Publications.
- Gathercole SE, Alloway TP, Kirkwood HJ, Elliott JE (2008). Attentional and executive function behaviours in children with poor working memory. *Learn. Individ. Differences*, 18: 214-223.
- Gathercole SE, Lamont E, Alloway TP (2006). Working memory in the classroom. In S. Pickering and G. Phye (Eds.), *Working*

- memory and education. US: Academic Press, pp. 219–240
- Gathercole S, Alloway T, Kirkwood H, Elliott J, Holmes J, Hilton K (2008). Attentional and executive function behaviours in children with poor working memory. *Learn. Individ. Differences*, 18: 214-223.
- Gioia GA, Isquith PK, Guy S, Kenworthy L (2000). Behaviour rating inventory of executive function. Psychological Assessment Resources, Inc, Florida, USA.
- Geary DC, Hoard MK, Hamson CO (1999). Numerical and arithmetical cognition: Patterns of functions and deficits in children at risk for a mathematical disability. *J. Exp. Child Psychol.*, 74: 213-239.
- Holmes J, Gathercole SE, Dunning D (2009). Adaptive training leads to sustained enhancement of poor working memory in children. *Dev. Sci.*, 12: 9-15.
- Jaeggi SM, Buschkuhl M, Jonides J, Perrig WJ (2008). Improving fluid intelligence with training on working memory. *Proceedings of the National Academy of Science USA*, 105: 6829-6833.
- Just M, Carpenter P (1992). A capacity theory of comprehension: Individual differences in working memory. *Psychol. Rev.*, 99: 122-149.
- Martinussen R, Hayden J, Hogg-Johnson S, Tannock R (2005). A Meta-Analysis of Working Memory Impairments in Children with Attention-Deficit/Hyperactivity Disorder. *J. Am. Acad. Child Adolesc. Psychiatry*, 44: 377-384.
- Swanson HL (1999). What develops in working memory? A life span perspective. *Dev. Psychol.*, 35: 986-1000.
- Swanson HL, Beebe-Frankenberger M (2004). The relationship between working memory and mathematical problem solving in children at risk and not at risk for math disabilities. *J. Educ. Psychol.*, 96: 471-491.
- Swanson HL, Sachse-Lee C (2001). Mathematical problem solving and working memory in children with learning disabilities: Both executive and phonological processes are important. *J. Exp. Child Psychol.*, 79: 294-321.